

Repair Plate Research Results Released

The Pallet and Container Research Laboratory, Virginia Polytechnic Institute and State University, in cooperation with NWPCA and the Southeastern Forest Experiment Station (USDA Forest Service), embarked on a research project two years ago to evaluate the use of metal connector plates (MCP) for the repair and reinforcement of stringer-class pallets. According to Tom McLain, VPI, Phase I of the project has now been completed.

The objectives of Phase I were to:

- evaluate the ability of different MCP styles to restore the bending strength of broken stringers;
- explore the potential of MCP for reinforcing new stringers; and
- evaluate several of the specific provisions in the NWPCA interim voluntary guidelines for MCP repair.

To evaluate repair using plates, researchers tested to failure six identical groups of new, undamaged notched oak stringers, 1 1/2" wide, in a simulated racked across stringers (RAS) support mode. Broken stringers were then repaired with different plates according to NWPCA's guidelines. Researchers then tested the repaired stringers to determine performance.

"On average, the stringers repaired with MCP were stronger by 16-27%, but were less stiff by 2-13," said McLain. "No practical difference was found in the ability of the six different MCP to restore bending strength of broken oak stringers." There was only a slight difference between MCP in their ability to restore bending stiffness.

With southern yellow pine stringers a separate study using only one plate style showed both the strength and

stiffness could be restored. Additionally, there was no effect of stringer width on plate repair performance within a species.

The project also showed the vast majority of stringer failures are at the notch, not over the notch. Researchers conducted bending tests on above-notch segments of stringers to determine their strength. Neither strength nor stiffness of the notched segments could be restored by MCP repair. In addition, no practical differences were found between the performance of the five different above notch MCP tested.

The project also evaluates the splitting of stringer end feet. Researchers developed an impact test procedure to test the ability of MCP to repair stringer end feet broken by fork tines. Repaired oak and southern yellow pine end feet were found to withstand more tine impacts (51 -36%) than the original, unplated end feet. A parallel tooth MCP design performed better than the X-shaped plug design, however both were effective in repairing damaged ends. There was also a greater benefit to end repair with MCP for oak stringers than for southern yellow pine stringers.

The study also revealed that for notched oak stringers, mechanically closing the notch crack before plate repair was no more effective than hand closing the notch with respect to repaired strength and stiffness. However, the laboratory stringers were cleanly broken, free of nails and attached deckboards. "It is likely that mechanical closing in an industrial setting will result in a more consistent, higher quality repair than hand closing," said McLain.

NWPCA guidelines recommend that two pair of plates be used on notch

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fractures over 8 inches in length. Tests revealed the 8 inch limit could be changed to 12 inches. However, since measuring the actual length of a crack in worn lumber can be difficult and the placement of plates in the field may vary, no change in the guidelines is recommended.

Finally, the study evaluated the effect of MCP when used to reinforce new stringers. Reinforced stringers were stronger in bending by 24-108% than equivalent unreinforced stringers. Reinforced end feet were found to withstand 34- 117% more fork tine impacts than the equivalent unreinforced end feet. Southern yellow pine stringers gained the most from reinforcement between the notch, while oak and yellow poplar gained the most from end foot reinforcement.


Preliminary tests of whole pallets, after accelerated long term handling, supported the results from the tests of individual stringers, notch segments and end feet. Further whole pallet tests are needed to verify that individual plate design has no effect on performance.

The next phase of the cooperative plate repair research will be used to develop a performance standard for repaired wood pallets. This will include tests of used pallets and components, and will explore any relationship between the physical condition of the pallet and the repair method on the performance of the repaired product. Specifically, Phase II will test the relative performance of new MR, R1, R2, R3, R4 repairs as specified in NWPCA's new Voluntary Uniform Standard for Wood Pallets, as well as MCP repairs on GMA style wood pallets.

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